Computing Reliabilities of Large Consecutive-Type Systems

Galit Shmueli
Department of Decision & Information Technologies
Robert H Smith School of Business
University of Maryland, College Park
gshmueli@umd.edu

The literature on consecutive-type systems includes various methods for computing the system reliability. However, in most cases the reliability is in recursive form such that for a system with n components n computations are needed. When n is very large this can be computationally expensive. In this talk we present a new method for deriving exact expressions for the generating functions and reliabilities of various consecutive-type systems. Our method is based on Fellers run theory. It is easy to implement and it leads to both recursive and non-recursive formulas for the reliability. We focus on the non-recursive expressions, which are especially advantageous for systems with numerous components. The computation involves finding the roots of a k order polynomial, where k is the length of the failure-causing pattern. We show how the method can be extended for computing generating functions and reliabilities of systems with multi-state components of two types: those where the states of a component are mutually exclusive (e.g., different types of failures) and those where the states are ordered (e.g., gradual degradation).